Diabetes Surveillance

with the

Electronic Support for Public Health
Public Health Surveillance Platform

November 18, 2010

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Outline

Electronic health records for public health surveillance

1. Infectious disease case reporting
2. Syndromic Surveillance
3. Frank Diabetes
4. Gestational Diabetes

"No health department, State or local, can effectively prevent or control disease without knowledge of when, where, and under what conditions cases are occurring"

Introductory statement printed each week in *Public Health Reports*, 1913-1951

from www.sciencewatch.com (November 12, 2010)

Our Goal:
Create a complement to BRFSS and NHANES

BRFSS
outstanding breadth of coverage

…but expensive, time consuming, limited clinical detail

NHANES
outstanding clinical detail

…but expensive, time consuming, limited population coverage

Our Goal
automated disease surveillance using data routinely stored in electronic health records

clinically detailed, efficient, & timely disease surveillance from large, diverse populations without added work & cost for health departments or clinicians

Electronic Support for Public health (ESP)

- Software and architecture to extract, analyze, and transmit electronic health information from providers to public health.
  - ✓ Surveys codified electronic health record data for patients with conditions of public health interest
  - ✓ Generates and sends secure electronic reports to the state health department
  - ✓ Designed to be compatible with any EHR system

JAMIA 2009;16:18-24
MMWR 2008;57:372-375
Advances Disease Surveillance 2007;3:3

ESP – history and current directions

- Funded by CDC starting in 2005
- Initial funding for infectious disease surveillance
  - ✓ Reportable diseases
  - ✓ Syndromic surveillance
- New CDC funding late 2009 to add chronic disease surveillance
  - ✓ Diabetes

esphealth.org

ESP

CDC Center of Excellence in Public Health Informatics

Electronic Support for Public health

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Welcome to the ESP Project web site, Wiki, and source code (Subversion) repository

This is a web site for the Electronic medical record Support for Public health (ESP) project, part of a CDC funded Center of Excellence in Public Health Informatics. The ESP project is a collaboration between Harvard Medical School, Harvard Pilgrim Health Care, Massachusetts Department of Public Health, Atrius Health, and the Channing Laboratory of Brigham and Women's Hospital.

ESP is a secure, automate ... assachusetts Department of Public Health. This pre-pri ... ontinuously since, providing valid, comprehensive, secu ...

The growing use of electro ... practice, offering an unparalleled opportunity t ... ent information, as well as patient demographic data. ... ging from electronic medical record systems to public h ...

The system currently repo ... ctive tuberculosis. In collaboration with the Mas ... combinations of laboratory orders and results, ICD9 d ... ment.

Source code and documentation available free of charge from esphealth.org

Project Publications

Electronic Support for Pub	PDF
Automated Identification	HTML
Automated Detection and ... ly 2007	PDF
Electronic medical record ... es	PDF
Invited Commentary: Aut	PDF
Klompas et al. Respond: A	PDF

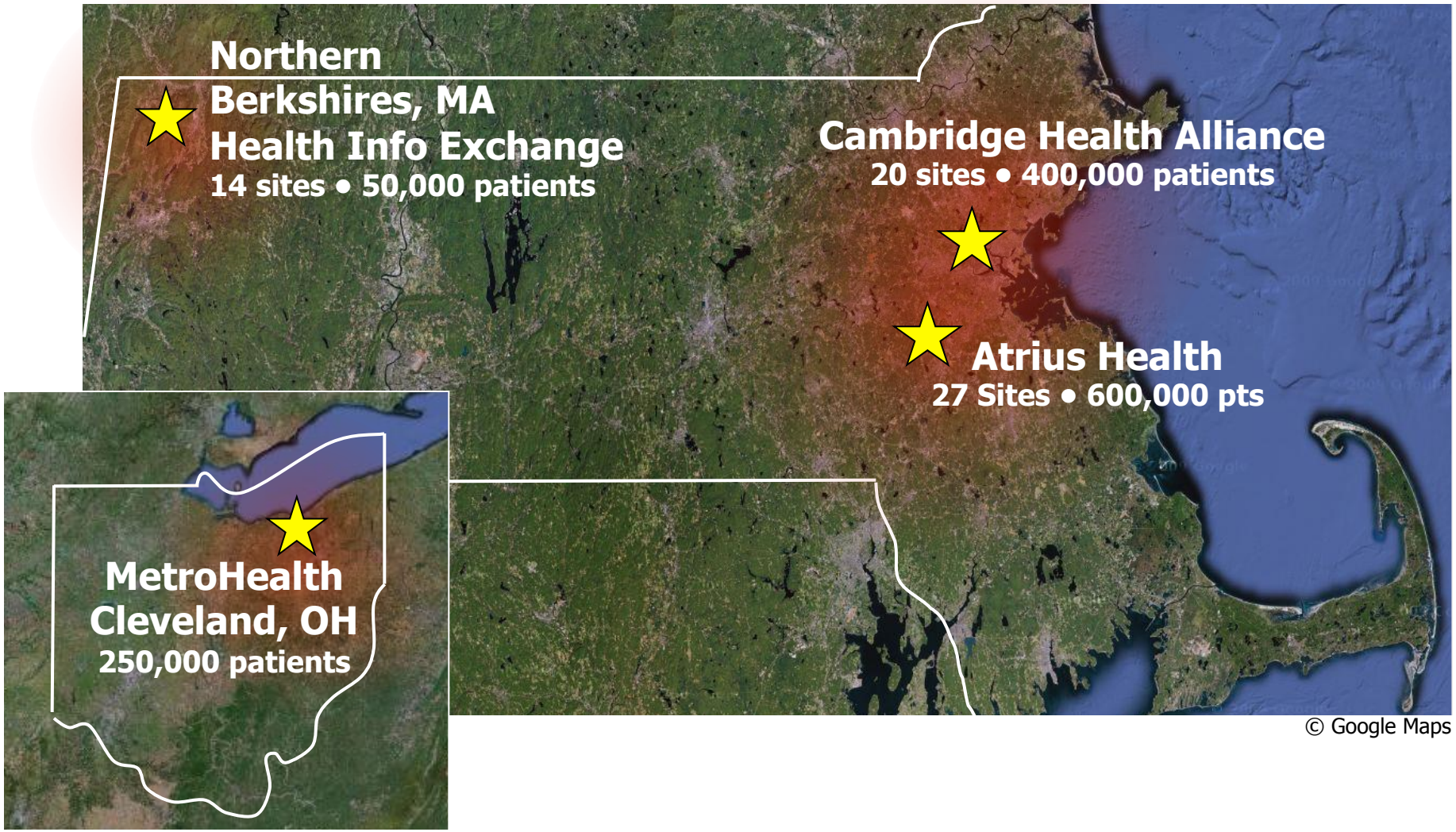
Key personnel in the project include:

- Richard Platt - principal investigator (Richard_Platt at harvard dot edu)
- Ross Lazarus - ESP informatics lead and ESP:VAERS principal investigator (Ross.Lazarus at channing dot harvard dot edu)
- Michael Klompas - clinical lead (mklompas at partners dot org)
- Julie Dunn - administrative lead (Julie_Dunn at harvardpilgrim dot org)

Project Details and resources

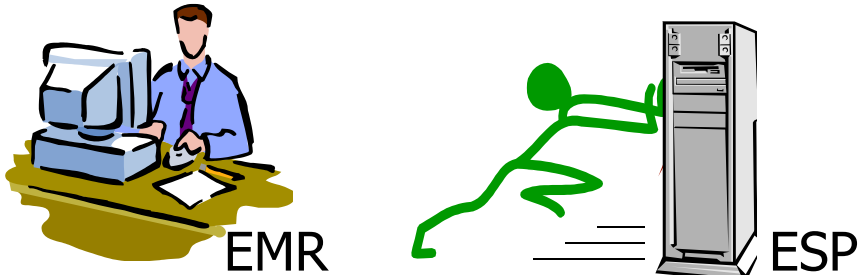
- **Discussion Forums** Once you've registered and confirmed your email address, you can post to the forums
- **Software dependencies**

Current ESP installations



Challenges in creating a generalizable disease EMR-based reporting system

- Compatibility with different EMR systems
- Cannot interfere with practitioners' workflow
- Cannot slow the clinical information system
- Security of clinical data
- Heterogenous coding for similar tests
- Test codes change over time
- Disease identification

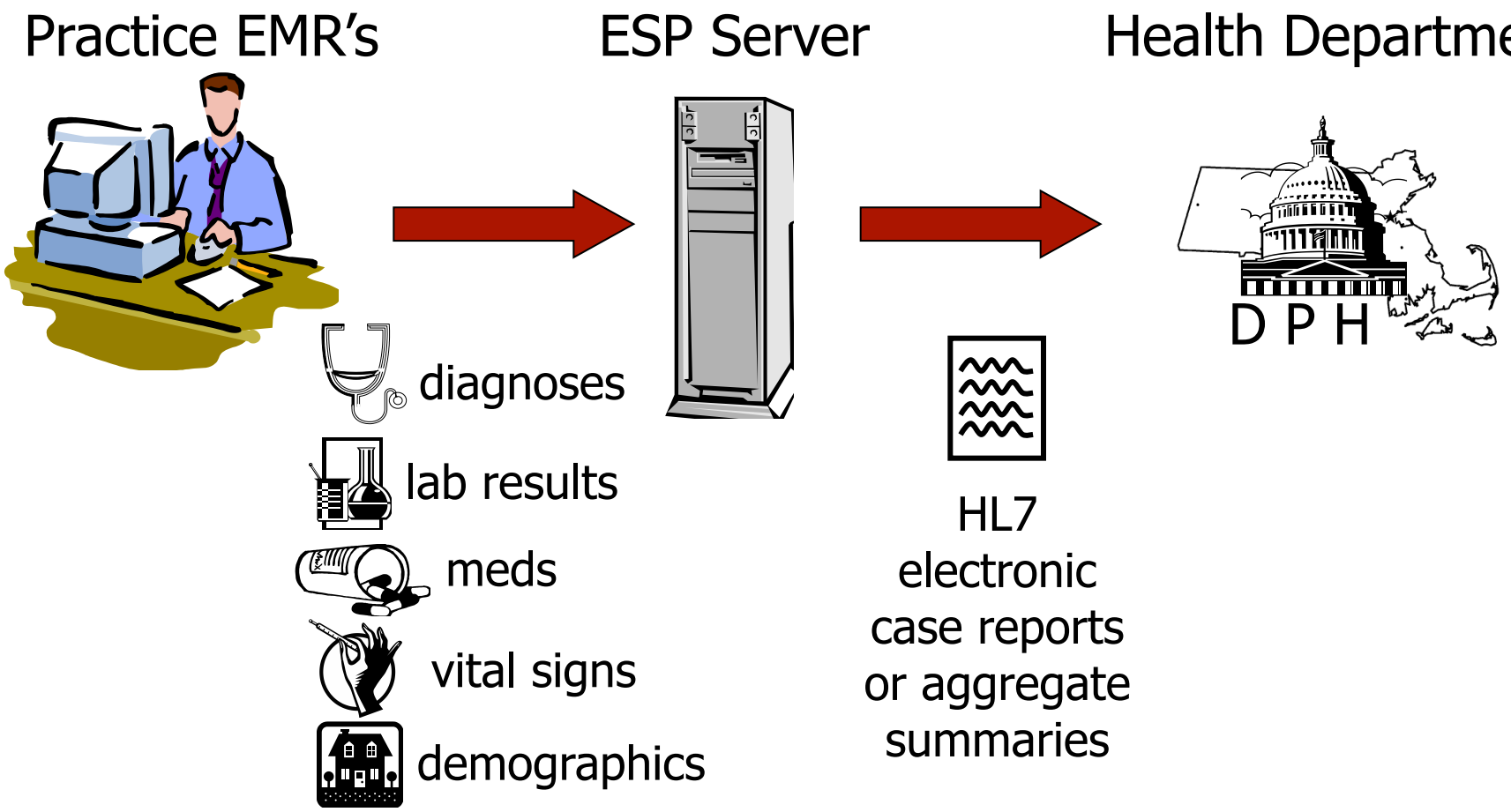


Decoupled architecture

ESP decoupled from host electronic medical record

	Implications
Allows system to be agnostic to the source EMR (local codes translated to common nomenclature)	**Universal**
Offloads computing burden from clinical systems (and keeps ESP invisible to clinicians)	**Unobtrusive**
Can still remain within host practice's firewall	**Secure**

ESP: Automated disease detection and reporting for public health



JAMIA 2009;16:18-24

Electronic Case Reports for Notifiable Diseases

- Patient demographics
- Responsible clinician, site, contact info
- Basis for condition being detected
- Treatments prescribed
- Symptoms (ICD9 code & temperature)
- Pregnancy status (when pertinent)
- Vaccine history (when pertinent)

Aggregate Summaries for Diabetes "The RiskScape"

- Novel communication & visualization interface under development to provide aggregate reporting
- Include statistical tools for cluster analysis by location, race/ethnicity, age, etc.
- Provide contextual data (infrastructure, education, income, food availability, etc.) from publicly available datasets
- Mechanisms for health department to manipulate and extract summary data

**** Work in Progress ****

CASE IDENTIFICATION

Case Identification

Limitations of diagnosis by ICD9's

Condition	Sensitivity	Positive Predictive Value
Acute hepatitis C	63%	22%
Postherpetic neuralgia	59%	84%
Gestational diabetes	91%	53%

Solution

- Integrate multiple streams of data from the EMR to increase sensitivity and specificity
  - ✓ Lab orders
  - ✓ Lab results (present and past)
  - ✓ ICD9 diagnoses (present and past)
  - ✓ Medication prescriptions

Case Identification Logic:
Acute Hepatitis B

- **Both** of the following:
  - ✓ ICD9 for jaundice OR liver function tests > 5x normal
  - ✓ IgM to core antigen

OR

- **All four** of the following:
  - ✓ ICD9 for jaundice OR liver function tests > 5x normal
  - ✓ Hep B surface antigen or 'e' antigen present
  - ✓ No prior positive Hep B specific lab tests
  - ✓ No present or prior ICD9 code for chronic hepatitis B

Sensitivity:	**99%**
PPV:	**97%**

PLoS ONE 2008:3:e2626

INFECTIOUS DISEASE CASE REPORTING

ESP Case Reporting

Atrius Health, June 2006-November 2010

Condition	Total Cases	False Positives*	Positive Predictive Value
Chlamydia	4007	0	**100%**
Gonorrhea	433	0	**100%**
Pelvic inflammatory disease	65	1	**97%**
Acute hepatitis A	17	0	**100%**
Acute hepatitis B	21	1	**94%**
Acute hepatitis C	43	0	**100%**
Tuberculosis	29	1	**96%**
Syphilis	195	0	**100%**

* False positives defined as non-reportable cases

Manual versus electronic reporting

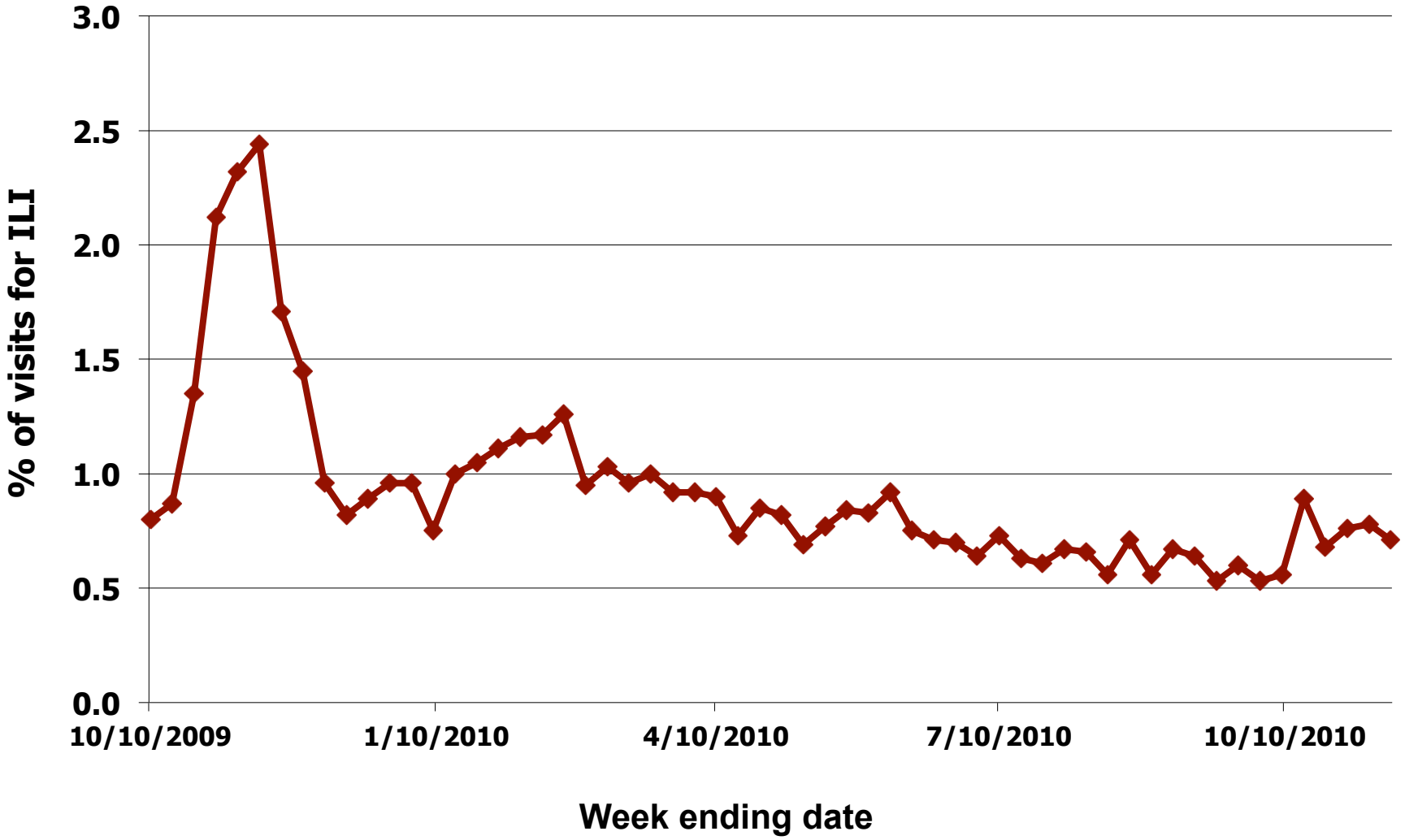
Atrius Health (variable time periods)

	Manual Reports*	ESP	Change
Chlamydia	545	758	↑ **39%**
Gonorrhea	62	95	↑ **53%**
Pelvic Inflammatory Disease	0	25	↑ ↑
Acute Hepatitis B	3	8	↑ **140%**
Acute Hepatitis C	14	38	↑ **150%**
Tuberculosis	13	14	↑ **8%**

MMWR 2008;57:372-375
PLoS ONE 2008;e2626
Public Health Reports 2010;125:843

SYNDROMIC SURVEILLANCE

Syndromic Surveillance
Influenza-Like Illness, Atrius Health, 2009-2010



FRANK DIABETES

Criteria for Frank Diabetes

- Hemoglobin A1C ≥ 6.5
- Fasting glucose ≥126
- Random glucose ≥200 on two or more occasions
- Prescription for INSULIN outside of pregnancy
- ICD9 code 250.x (DM) on two or more occasions
- Prescription for any of the following:
  - ✓ GLYBURIDE, GLICLAZIDE, GLIPIZIDE, GLIMEPIRIDE
  - ✓ PIOGLITAZONE, ROSIGLITAZONE
  - ✓ REPAGLINIDE, NATEGLINIDE, MEGLITINIDE
  - ✓ SITAGLIPTIN
  - ✓ EXENATIDE, PRAMLINTIDE

Validation of Diabetes Detection Algorithm

- 110 randomly selected charts reviewed
  - ✓ 107 cases type 1 or type 2 diabetes
  - ✓ 2 cases of gestational diabetes
  - ✓ 1 false positive

Source of false positive

GLUCOSE TOLERANCE 3 HOUR OB

Status: **Final result** MyHealth:

	Value	Range
GLUCOSE, 3 HR, POST 100 GM	**89**	65 - 94 MG/DL
Comments: (FASTING)		
GLUCOSE, 1 HR, POST 100 GM	**168**	65 - 179 MG/DL
Comments: (1 HR)		
GLUCOSE, FASTING	**144**	65 - 154 MG/DL
Comments: (2 HR)		
GLUCOSE, 2 HR, POST 100 GM	**79**	65 - 139 MG/DL
Comments: (3 HR)		

Lab Flowsheet

Diabetes mellitus

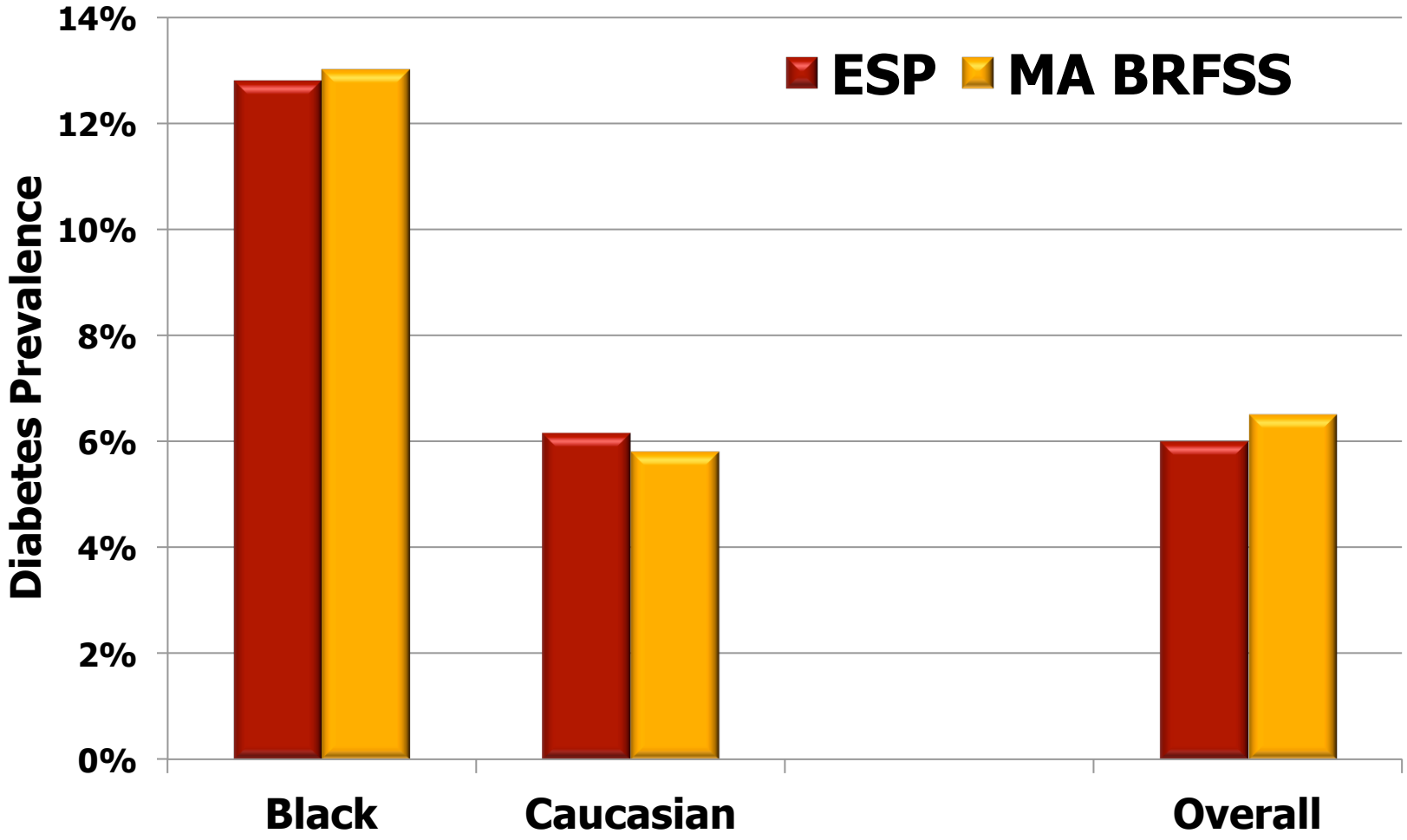
Atrius Health, June 2006-present

- Patients under surveillance: 717,018
- Patients flagged: 43,117
- Diabetes prevalence: 6.0%

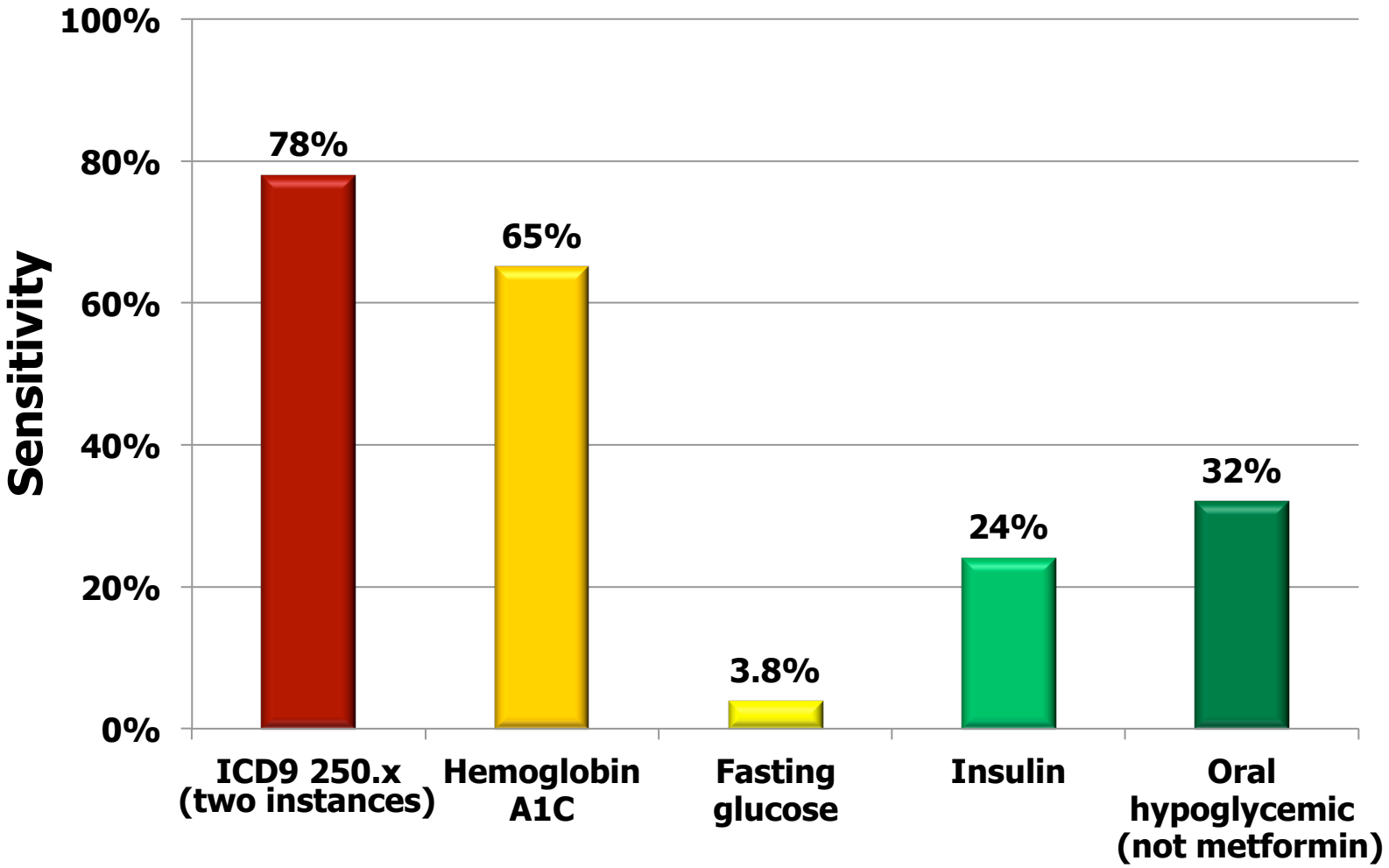
Compare with MA BRFSS (2006-2007)

Patients under surveillance:	21,507
Diabetes prevalence	6.5%

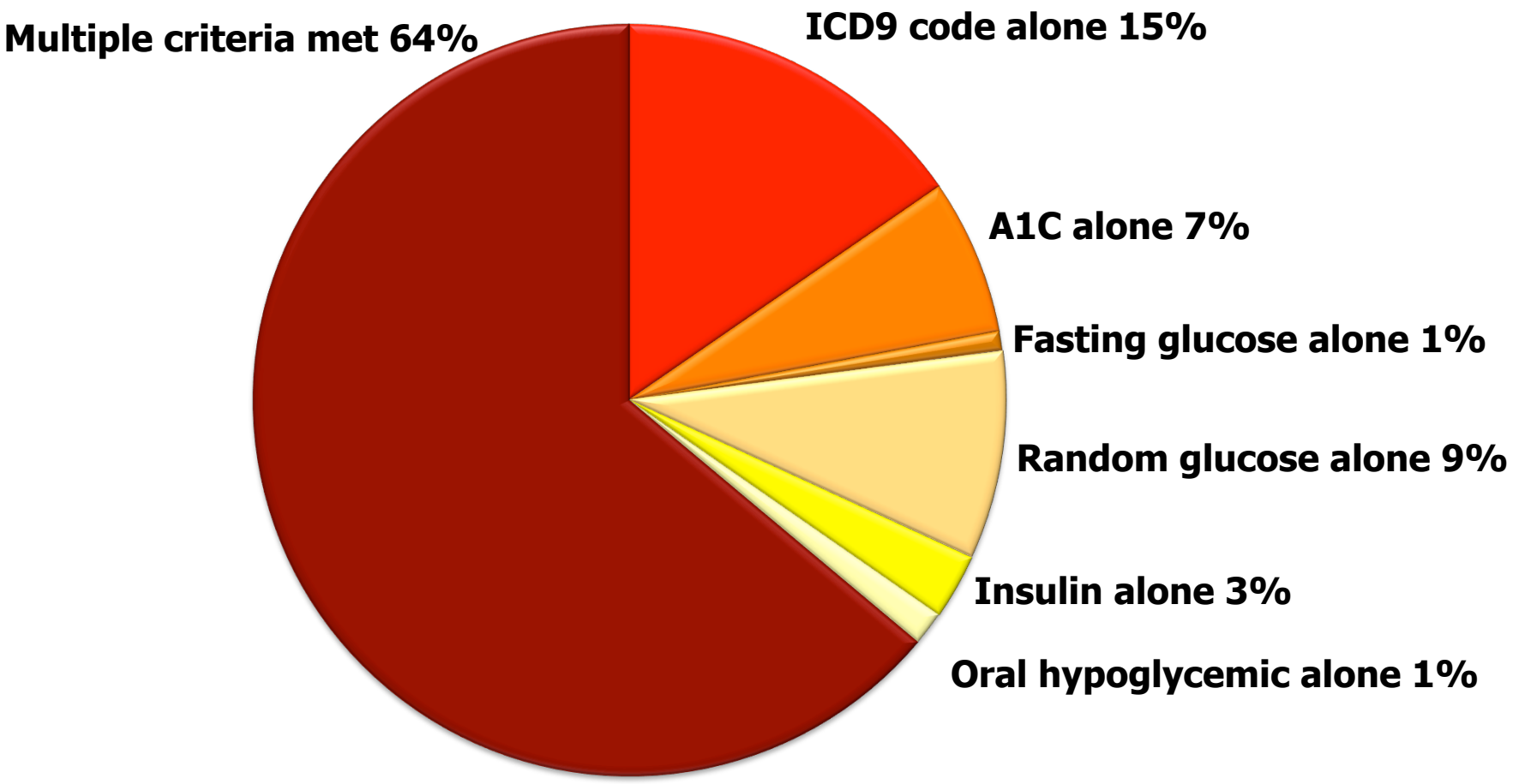
Diabetes prevalence by race ESP versus BRFSS



Sensitivity of definition components

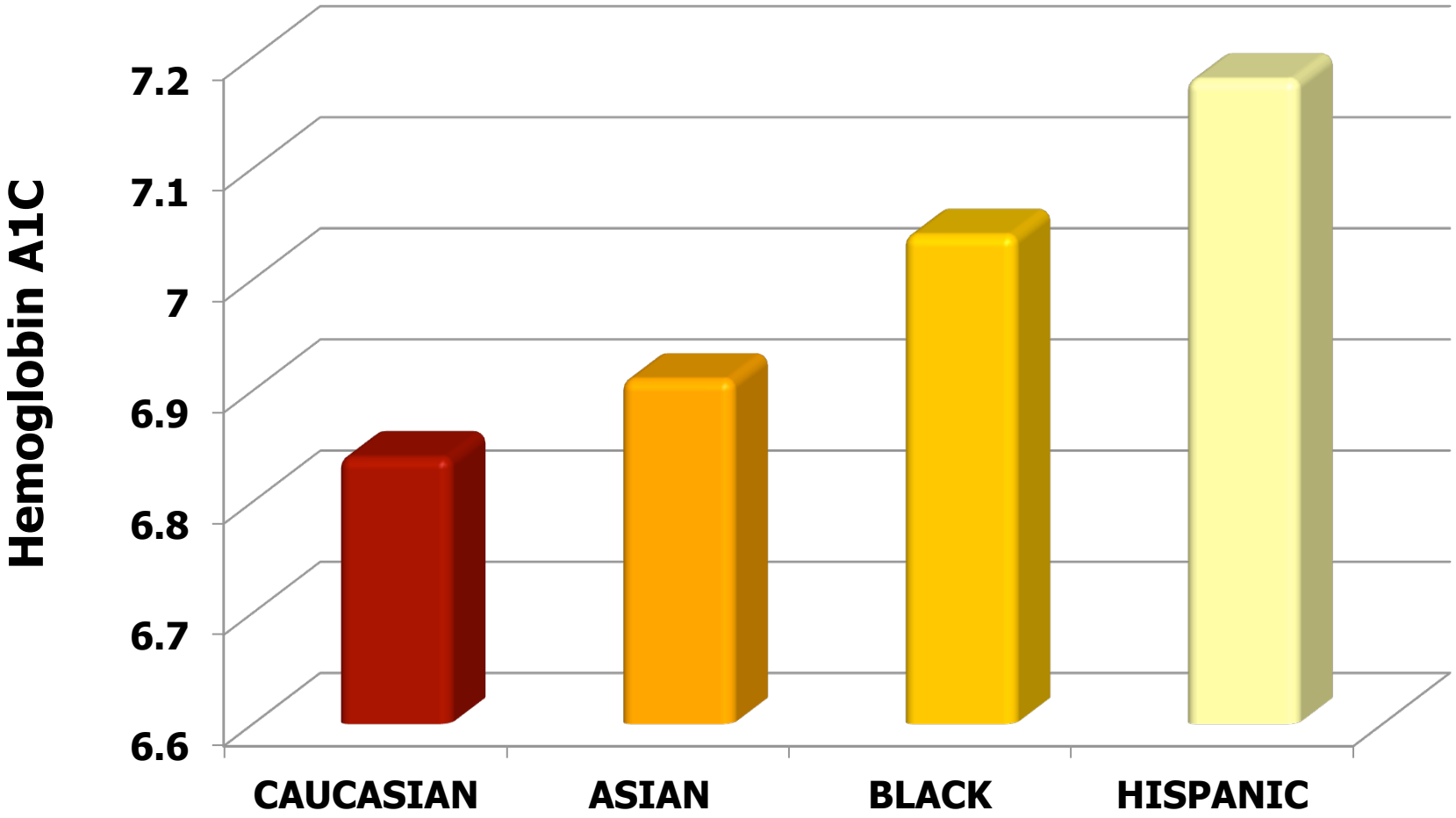


Cases Captured Exclusively by One Definition Component

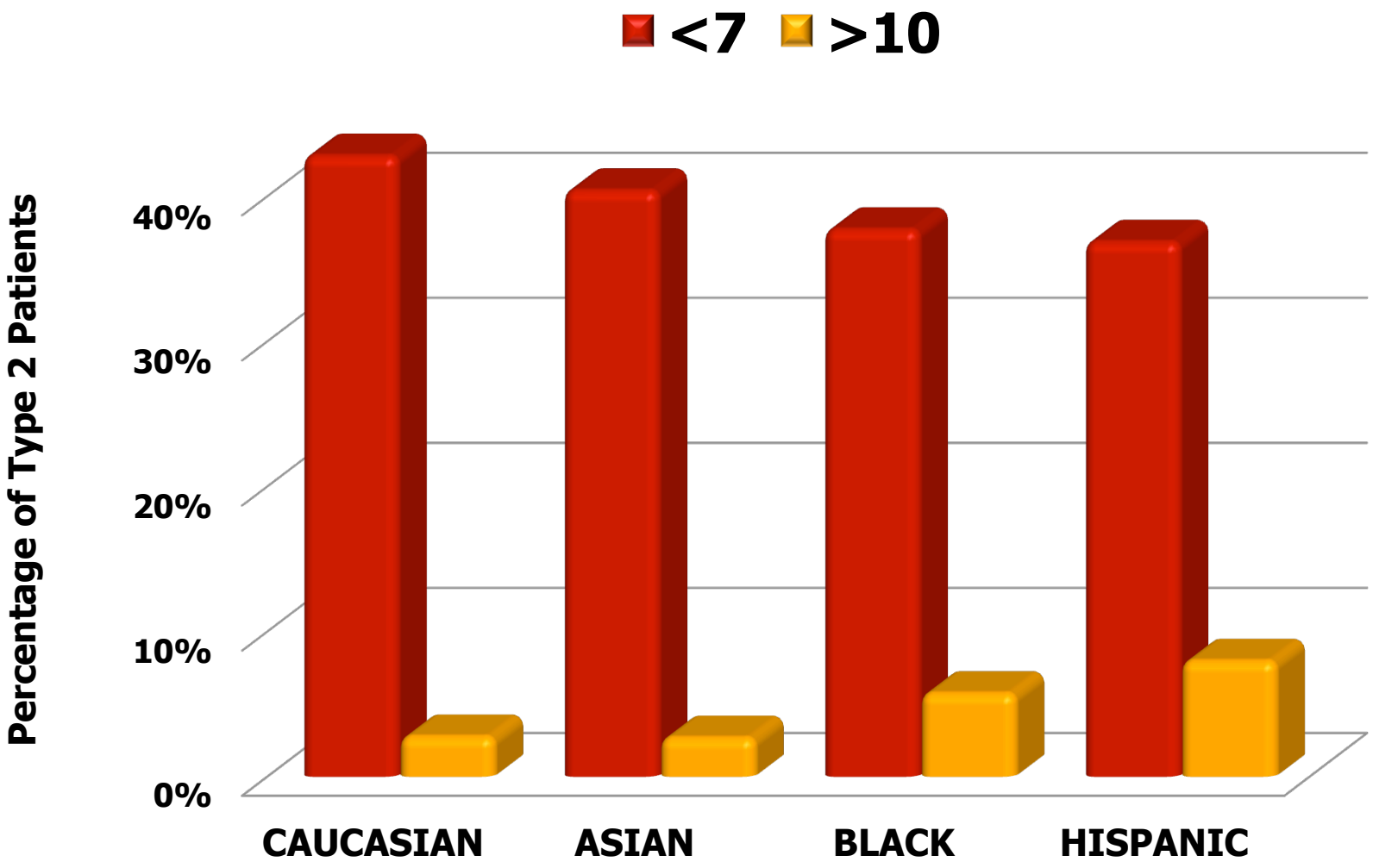


OUTCOMES

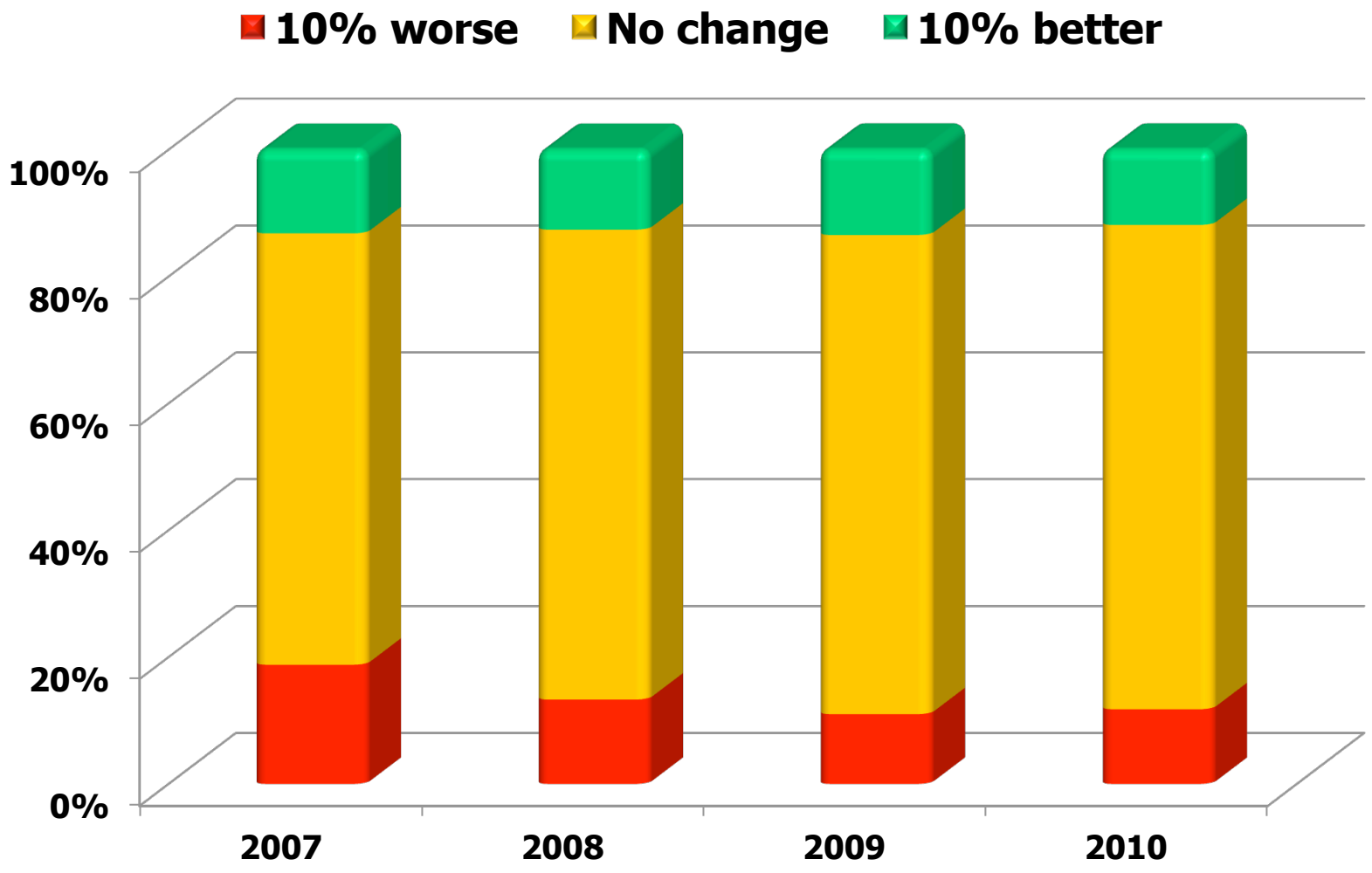
Average Hemoglobin A1C at Diagnosis



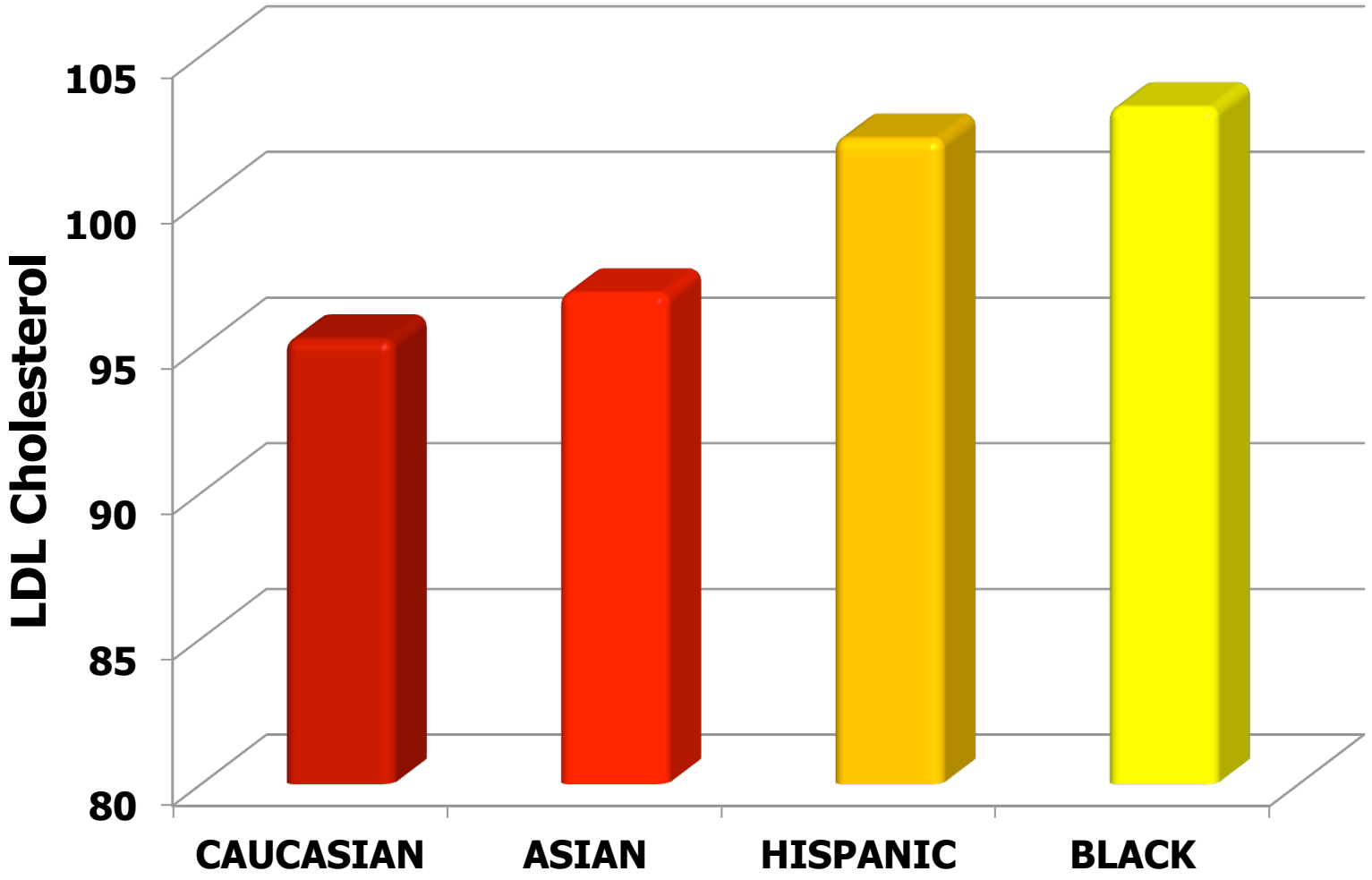
Most Recent Hemoglobin A1C



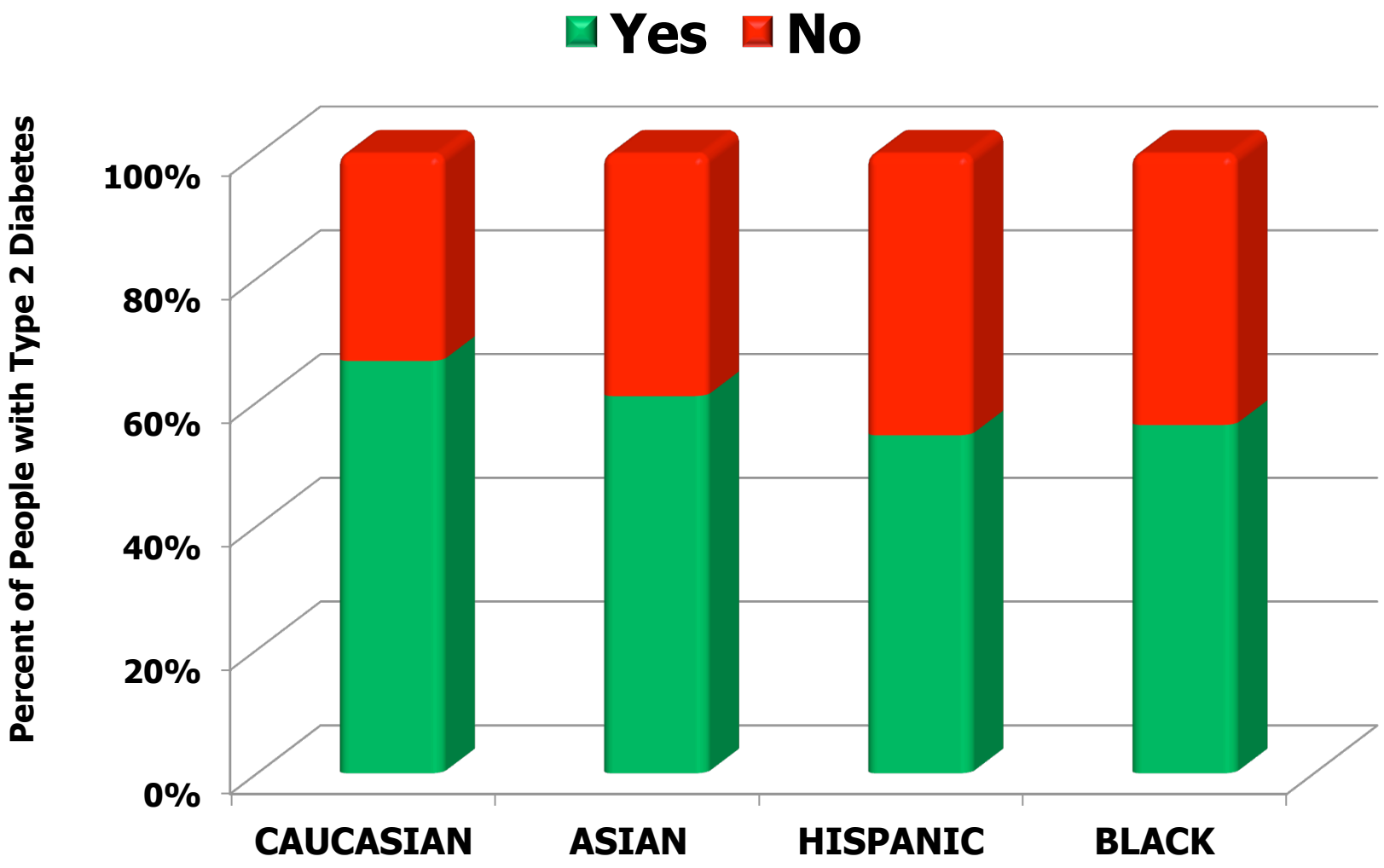
Change in Hemoglobin A1C on Previous Year



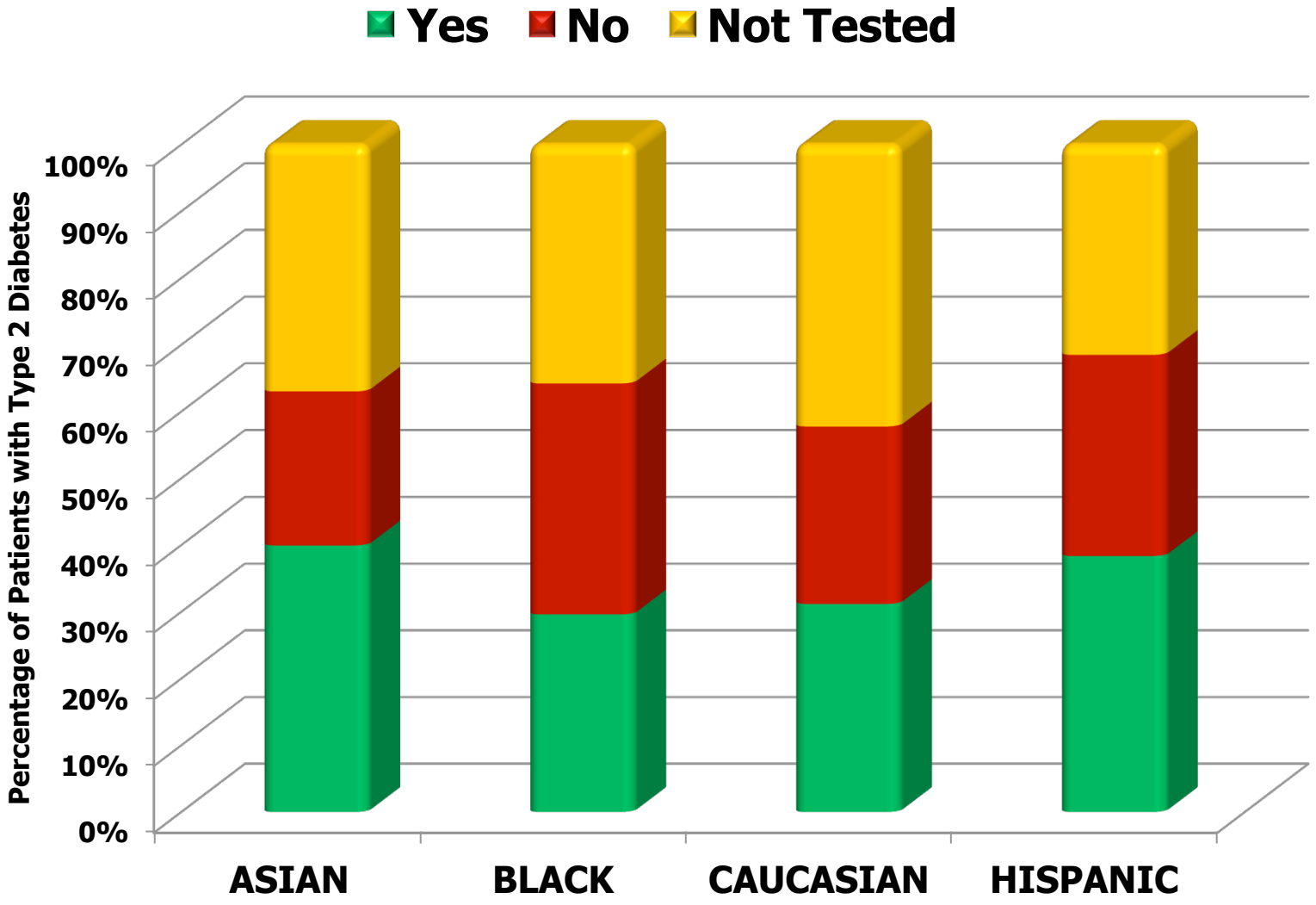
Average LDL Cholesterol



Cholesterol at Goal



Blood Pressure at Goal



GESTATIONAL DIABETES

Gestational Diabetes

- Formal laboratory criteria for diagnosis (oral glucose tolerance tests)

but…

- What if patient diagnosed in another practice or in an atypical but clinically reasonable manner?

Possible search criteria for gestational diabetes

1	Positive oral glucose tolerance test 50 gram 75 gram 100 gram
2	ICD9 648.8x (gestational diabetes)
3	Pregnant and ICD9 648.8x
4	Pregnant and new Rx for lancets or test strips
5	Pregnant, ICD9 648.8x, new Rx for lancets or test strips

Apply to ESP
Review a sample of charts

Oral Glucose Tolerance Tests

	Cases	Estimated Sensitivity	Positive Predictive Value
50g oral glucose tolerance	174	18%	100%
75g oral glucose tolerance	47	5%	100%
100g oral glucose tolerance	649	65%	100%

Alternative criteria
(preliminary figures, subject to confirmation)

	Patients Flagged	Estimated Sensitivity	Positive Predictive Value
ICD9 648.8x	1725	91%	53%
Pregnant and ICD9 648.8x	1301	89%	68%
Pregnant , new Rx for test strips or lancets	1061	87%	82%
Pregnant, ICD9 648.8x, new Rx test strips or lancets, no history of frank diabetes	811	82%	100%

Pregnant, ICD9 for GDM, New Rx for lancets or test strips

- Detects 811 individuals
  - ✓ 192 without +OGTT tests
- Reviewed 50 random individuals
  - ✓ 27 with +OGTT tests in ESP
  - ✓ 23 without +OGTT tests in ESP
    - ☞ 3 with pre-existing type 1 or type 2 diabetes
    - ☞ 20 with clinical diagnoses of gestational diabetes
      - ➢ 4 diagnosed at outside practices
      - ➢ 5 with “almost” abnormal OGTTs
      - ➢ 10 with history of GDM + high fingerstick / A1C this preg
      - ➢ 1 with missed abortion
- Approximately 1/3 of patients detected by this criteria have clinically valid cases of GDM but would be missed if doing surveillance using OGTTs alone

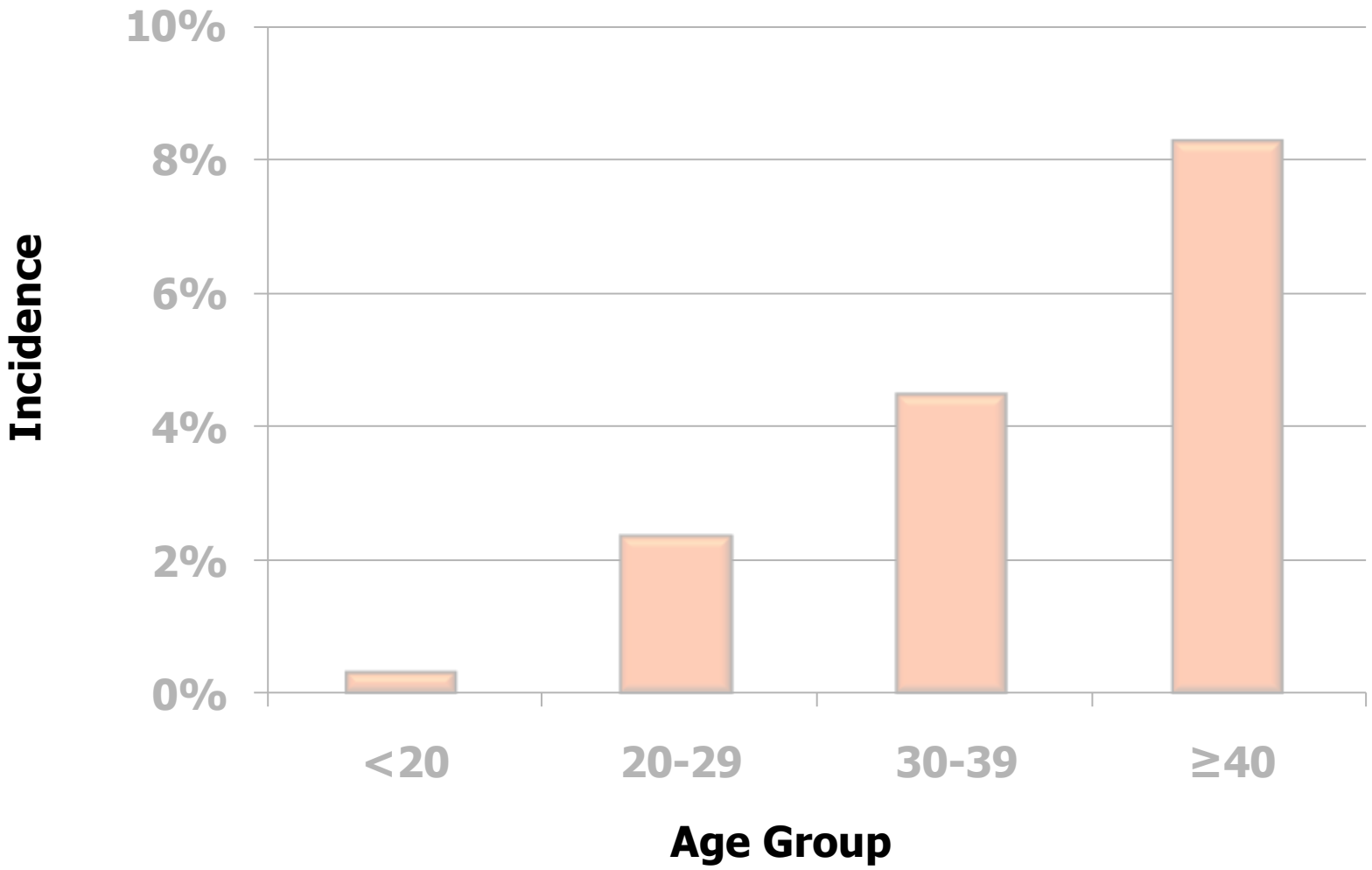
Optimized Algorithm

- Patient pregnant AND
  - ✓ Positive OGTT50 or OGTT75 or OGTT100

  OR
  - ✓ ICD9 for GDM and (Rx for lancets or test strips)
    - ☞ exclude if prior ICD9s for type1 or type 2 diabetes

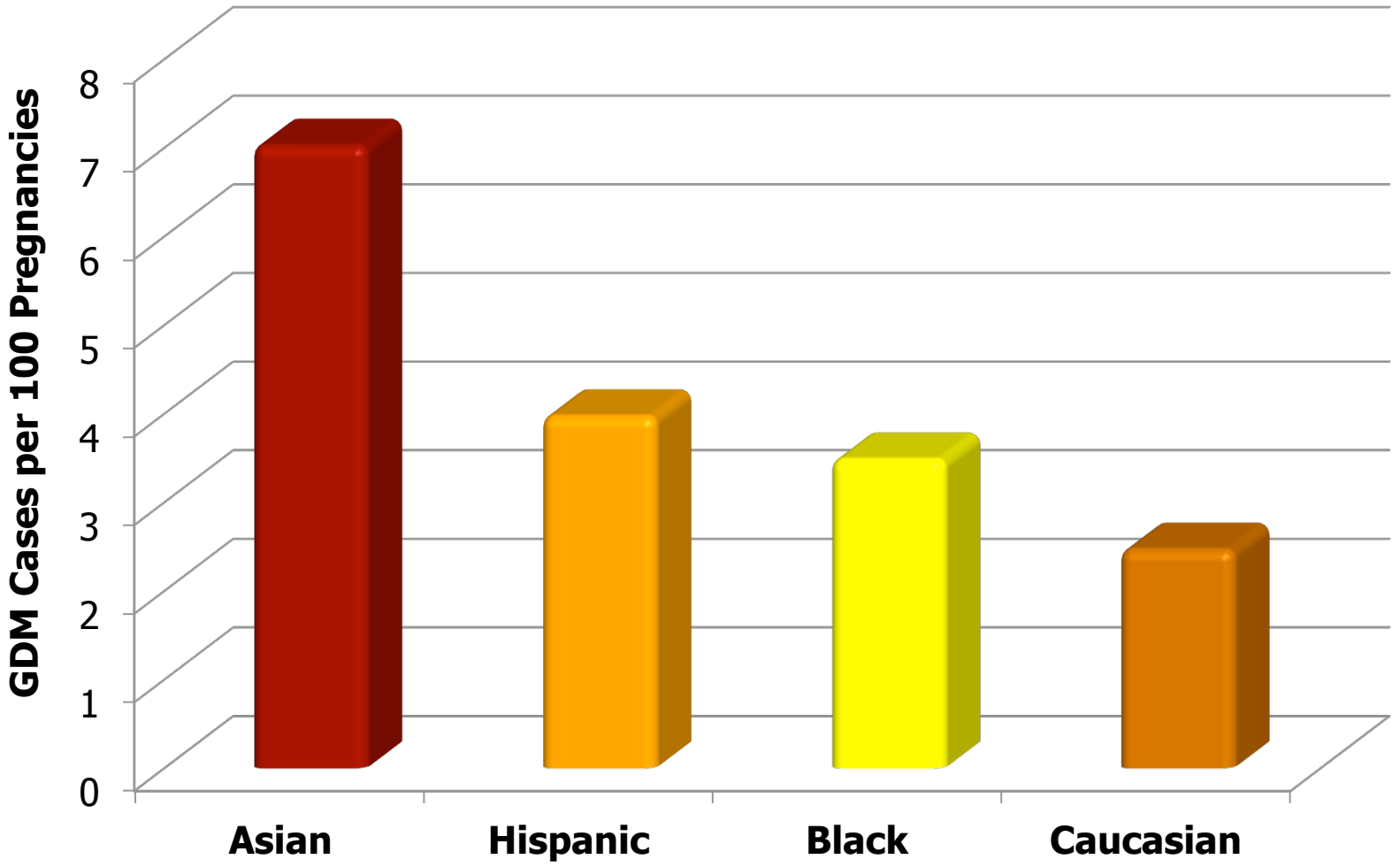
Incidence of Gestational Diabetes by Maternal Age

Atrius Health, 2006-2010

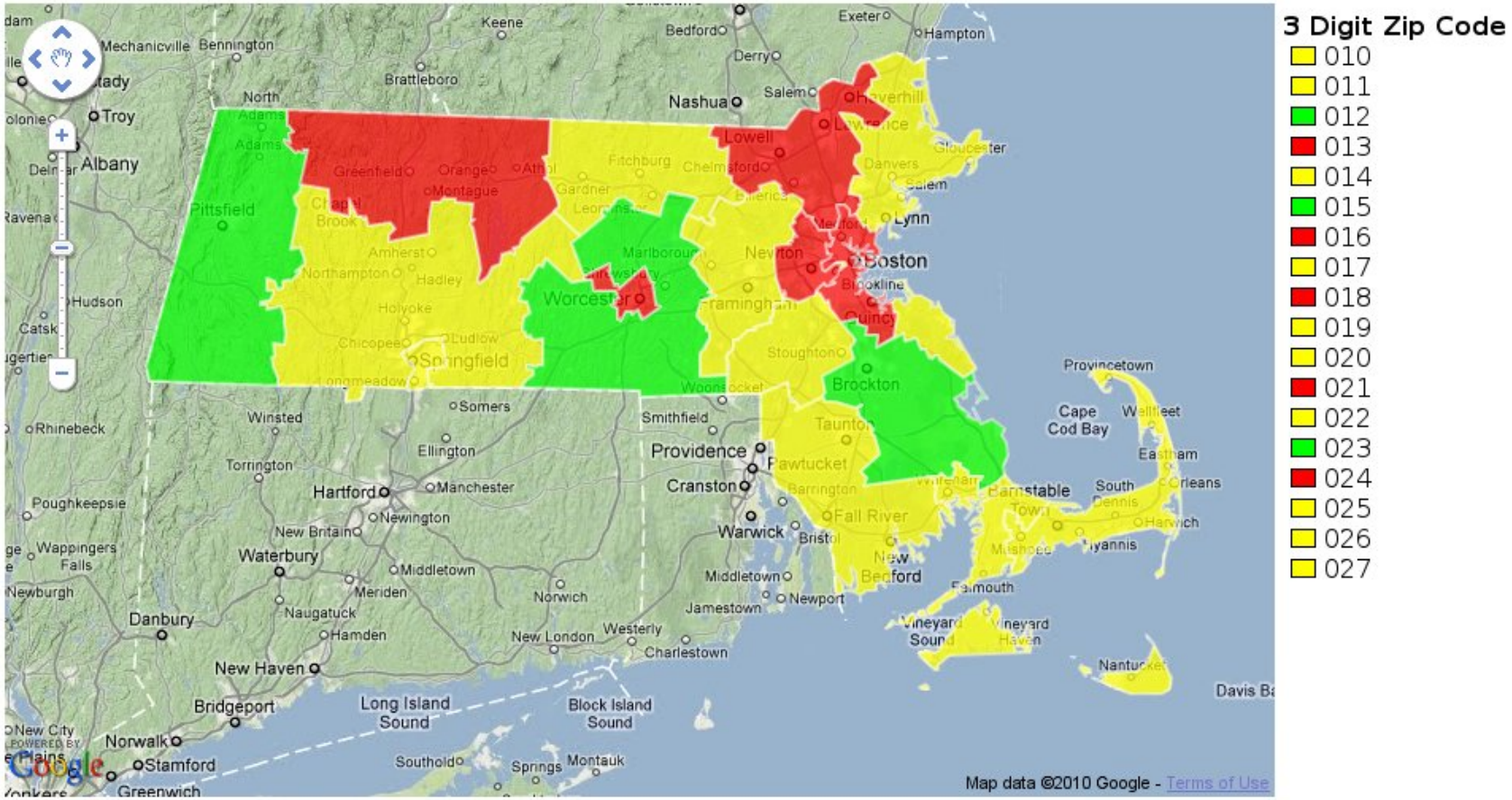


Incidence of GDM by Race

Atrius Health, 2006-2010



Gestational diabetes incidence by location
(simulated data)



Patterns of Care for Gestational Diabetics

Atrius Health, 2006-2010

	Percent
Referral for medical nutrition therapy	70%
Prescription for insulin	28%
Postpartum OGTT within 12 weeks	25%
Postpartum OGTT positive	
As percentage of all who were tested	5%
As percentage of all gestational diabetics	1%

Summary

- Electronic health records are a rich, largely untapped source for routine public health surveillance
  - ✓ Reportable diseases
  - ✓ Situational awareness
  - ✓ Chronic disease
- Added value beyond just case counts
  - ✓ Clinician / patient contact information
  - ✓ Clinical granularity (acute vs chronic, type 1 vs 2)
  - ✓ Race / ethnicity, age, sex, bmi, blood pressure, lab results
  - ✓ Patterns of care and complications
- Potential for real-time feedback on public health interventions
- Much unexplored territory…

ESP Team

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